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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/589,852	11/27/2006	Noboru Ichinose	PHKF-05004US	3677

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MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER	
WHALEN, DANIEL B	
ART UNIT	PAPER NUMBER
2829	
MAIL DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/589,852	ICHINOSE ET AL.	
	Examiner	Art Unit	
	DANIEL WHALEN	2829	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *25 June 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,5 and 8-21* is/are pending in the application.

4a) Of the above claim(s) *9-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,5,8 and 16-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 4, 5, 8, and 19-21 are objected to because of the following informalities: claims recite "the desired resistivity" without proper antecedent basis. Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. **Claims 16-18** are rejected under 35 U.S.C. 102(b) as being anticipated by Harwig et al. ("Electrical Properties of β-Ga_2O_3 Single Crystals. II,"; hereinafter "Harwig").

4. **Regarding Claim 16**, Harwig teaches a method of controlling a conductivity of a Ga203 system single crystal, comprising:

adding (doping) a predetermined dopant to the Ga_2O_3 system single crystal (β-Ga_2O_3 single crystal) such that said dopant is substituted for Ga in the Ga_2O_3 system single crystal to obtain a desired conductivity (page 205, introduction line 1-15, experimental line 1-13),

wherein said predetermined dopant comprises a p-type dopant (Mg; also applies to **claim 17** for p-type dopant) for controlling a conductivity of the Ga_2O_3 system single crystal, said p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Mg, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, T1, and Pb, said conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of said p-type dopant (fig. 1; page 205, introduction line 1-15, experimental line 1-13). It is noted that one of the ordinary skill in the art would recognize that when the predetermined dopant such as p-type dopant (Mg) is doped to the Ga_2O_3 system single crystal, the dopant is substituted for Ga in the Ga_2O_3 system single crystal. Furthermore, the recitation of "said dopant is substituted for Ga in the Ga_2O_3 system single crystal" is only a statement of the inherent properties of adding the dopant (e.g. Mg) to the Ga_2O_3 system single crystal. The structure recited in Harwig is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. Or where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. See In re Best, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding Claim 18, Harwig teaches that said n-type dopant (Zr) comprises one of Si, Hf, Ge, Sn, Ti, and Zr.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. **Claim 1, 4, and 5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig in view of Ueda et al. ("Synthesis and control of conductivity of ultraviolet transmitting β-Ga_2O_3 Single Crystal"; hereinafter "Ueda").

7. **Regarding Claim 1**, Harwig teaches a method of controlling a conductivity of a Ga_2O_3 system single crystal, comprising:

adding a predetermined dopant to the Ga_2O_3 system single crystal such that said dopant is substituted for Ga in the Ga_2O_3 system single crystal to obtain a desired conductivity (page 205, introduction line 1-15, experimental line 1-13),

wherein said predetermined dopant comprises one of:

a n-type dopant (Zr) for decreasing a resistance of the Ga_2O_3 system single crystal, said conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of said n-type dopant (fig. 1; page 205, introduction line 1-15, experimental line 1-13); and

a p-type dopant (Mg) for increasing a resistance of the Ga_2O_3 system single crystal, said conductivity of the Ga_2O_3 system single crystal being controlled dependently on an adding amount of said p-type dopant (fig. 1; page 205, introduction line 1-15, experimental line 1-13).

However, Harwig does not disclose that the predetermined dopant comprises one of: the n-type dopant comprising one of Si, Hf, Ge, Sn, and Ti, said conductivity of the ; and the p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb. Ueda discloses adding the dopants such as Sn to the Ga_2O_3 single crystal to control the conductivity (page 1361). Therefore, it would have been obvious to one of the ordinary skill in the art at the time of the invention to combine the teaching of Harwig with that of Ueda as the dopant such as Sn is readily available n-type dopant to the Ga_2O_3 single crystal.

It is noted that one of the ordinary skill in the art would recognize that when the predetermined dopant such as n-type dopant (Zr) or p-type dopant (Mg) is doped to the Ga_2O_3 system single crystal, the dopant is substituted for Ga in the Ga_2O_3 system single crystal. Furthermore, the recitation of "said dopant is substituted for Ga in the Ga_2O_3 system single crystal" is only a statement of the inherent properties of adding the dopant (e.g. Zr/Mg) to the Ga_2O_3 system single crystal. The structure recited in Harwig is substantially identical to that of the claims, claimed properties or functions are presumed to be inherent. Or where the claimed and prior art products are identical or substantially identical in structure or composition, or are produced by identical or substantially identical processes, a prima facie case of either anticipation or obviousness has been established. See In re Best, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding Claims 4 and 5, teaching of Harwig and Ueda has been discussed above. However, the combined teaching is silent as to describing numerical values of

the resistivity and a carrier concentration. It is noted that the combined teaching teaches an identical process, such as doping a predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as n-type dopant. Therefore, a value of 2.0 X 10^{-3} to 8.0 X 10^2 Ωcm as the desired resistivity by adding the n-type dopant and a carrier concentration within a range of 5.5 × 10^{15} to 2.0 X 10^{19} Ωcm are obtained. MPEP 2112.01.

Furthermore, applicant should note that it has held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

8. **Claim 8** is rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig and Ueda as applied to claim 1 above, and further in view of Ichinose et al. (US 2004/0007708 A1; hereinafter "Ichinose"). Teaching of Harwig and Ueda has been discussed above including controlling the electrical conductivity of the Ga_2O_3 system single crystal. However, although Harwig discloses doping Mg as the p-type dopant (Introduction), the combined teaching does not explicitly disclose p-type dopant comprising one of H, Li, Na, K, Rb, Cs, Fr, Be, Ca, Sr, Ba, Ra, Mn, Fe, Co, Ni, Pd, Cu, Ag, Au, Zn, Cd, Hg, Tl, and Pb. Ichinose discloses adding the p-type dopant such as zinc (Zn) to Ga_2O_3 single crystal (page 2). Therefore, it would have been obvious to one of the ordinary skill in the art at the time of the invention to combine the teaching of Harwig and Ueda regarding controlling the resistivity (resistivity is simply the reciprocal of its conductivity) with that of Ichinose regarding doping p-type dopant such as Zn as it

is readily available p-type dopant material choice to the Ga_2O_3 single crystal to obtain the desired resistivity. It is noted that the combined teaching of Harwig, Ueda, and Ichinose teaches an identical process, such as doping the predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as the p-type dopant. Therefore, a value of 1 X 10^3 Ωcm or more as the desired resistivity by adding the p-type dopant are obtained. MPEP 2112.01.

Furthermore, applicant should note that it has held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

9. **Claims 19-21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Harwig. Teaching of Harwig has been discussed above. However, Harwig is silent as to describing numerical values of the resistivity and a carrier concentration. It is noted that Harwig teaches an identical process, such as doping a predetermined dopant to the Ga_2O_3 system single crystal, and an identical material, such as n-type dopant and the p-type dopant. Therefore, a value of 2.0 X 10^{-3} to 8.0 X 10^2 Ωcm as the desired resistivity by adding the n-type dopant, a carrier concentration within a range of 5.5 × 10^{15} to 2.0 X 10^{19} Ωcm, and 1 X 10^3 Ωcm or more as the desired resistivity for adding p-type dopant are obtained. MPEP 2112.01.

Furthermore, applicant should note that it has held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Response to Arguments

Applicant's arguments filed 05/27/2008 have been fully considered but they are not persuasive.

In response to applicant's argument that the Examiner has failed to allege facts sufficient to support the allegation, Examiner respectfully traverses applicant's argument since Examiner clearly stated the distinction regarding newly submitted claims with the original claims in previous office action dated 03/26/2008 according to 37 CFR1.142(b) and MPEP 821.03.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., a purity of β-Ga_2O_3 Single Crystal is 6N) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Applicant further argues that there is no disclosure in Harwig regarding a conductivity controlled depending on an adding amount of a dopant. However, for instance in claim 16, applicant should note that the claim merely recites, "*adding a predetermined dopant…wherein said predetermined dopant comprises p-type dopant for controlling a conductivity of the Ga_2O_3 system single crystal*" Harwig clearly discloses doping Mg (group II element and p-type dopant to Ga_2O_3) that causes the reduction of the electrical conductivity of β-Ga_2O_3 Single Crystal (Introduction and Experimental). Applicant further argues that Harwig only shows a temperature

dependency of the conductivity of β-Ga_2O_3 Single Crystal. Examiner respectfully traverses applicant's argument. It is true that fig. 1 shows the conductivity of β-Ga_2O_3 Single Crystal, but it's not only parameter that controls the conductivity since Mg 1000 and Mg 100 are showing different conductivities at the same temperature. Therefore, Harwig clearly teaches that the conductivity of the Ga_2O_3 system single crystal is controlled by p-type dopant and the rejection is maintained.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANIEL WHALEN whose telephone number is (571)270-3418. The examiner can normally be reached on Monday-Friday, 7:30am to 5:00pm, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ha Nguyen can be reached on (571) 272-1678. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. W./
Examiner, Art Unit 2829
07/22/2008

Daniel Whalen
/Michael S. Lebentritt/

Primary Examiner, Art Unit 2829